Postel

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Guidelines for the use of Internet-IP addresses in the ISO Connectionless-Mode Network Protocol

Status of This Memo

This RFC suggests an addressing scheme for use with the ISO Connectionless Network Protocol (CLNP) in the Internet. This is a solution to one of the problems inherent in the use of "ISO-grams" in the Internet. This RFC suggests a proposed protocol for the Internet community, and requests discussion and suggestions for improvements. Distribution of this memo is unlimited.

This memo is a revision of RFC 986. Changes were made in order to allow the addressing used in the CLNP in the Internet to be potentially useful for routing in the context of new inter- and intra-domain routing protocols, and in the context of large numbers of networks and routing domains. The addressing scheme proposed in this RFC allows individual routing domains to make use of internal routing algorithms utilizing a variety of addressing formats, while still providing for a common addressing approach for use by inter-domain routing. These features are important due to the rapid growth currently being experienced in the Internet.

1. Objectives

The data communications protocols currently emerging out of the international standardization efforts warrant an early integration into the existing extensive Internet network infrastructure. The two possible approaches are a top-down one, where ISO applications like FTAM, X.400 and VTP are integrated on top of the transport function of the IP protocol suite, or a bottom-up approach where the whole ISO tower gets integrated without merging the two suites. The bottom-up approach may make use of the fact that the ISO-CLNP and the IP are very similar in function. This implies that it is reasonable to implement a multiprotocol function in some or all of the Internet gateways (potentially including part or all of the Internet environment). The result would be that at least large portions of the Internet, in particular the backbones, can become usable for full implementations of the ISO protocol stack.

A major problem with this approach is that there are open issues with

regard to the ISO addressing within the CLNP. In particular, the ISO network layer addressing standard allows a great deal of flexibility in the assignment of addresses, and a particular address format must be chosen. A further problem is the need for implementation and integration of routing facilities for the ISO-compatible subset of the Internet environment.

This paper proposed to use addresses which are considerably more flexible than the addresses used in the current IP Internet environment. This flexibility is necessary in order to allow some routing domains to base their internal routing protocol on addresses derived from the current IP addresses, to allow other routing domains to base routing on addresses in accordance to the intra-domain routing protocol being developed by ANSI and ISO [6], and to allow generality for a future inter-domain routing protocol.

The addressing scheme proposed here makes use of the concept of "routing domains" as used in ANSI and ISO. This concept is similar to, but not identical with, the concept of "Autonomous System" used in the Internet. Routing domains include a combination of gateways, networks, and end systems (not just gateways), and routing domain boundaries may be used to define associated access control and policy routing constraints. Like autonomous systems, routing domains may be assumed to be topologically contiguous. There is no a priori reason why routing domains assigned for use with the ISO IP need to have any particular relation with existing autonomous systems which have been assigned for use with the IP. The assignment of specific routing domain identifiers is an "assigned numbers" function which is necessary for use of the ISO IP in the Internet, but is beyond the scope of this document.

It is expected that this addressing scheme will be appropriate for long term use with the ISO IP in the Internet. However, it is also expected that in the long term, the Internet will be interconnected with other routing domains making use of other schemes, such as addresses assigned to commercial internets through ANSI, and addresses assigned by national standards organizations in other countries. This implies that, in the long term, gateways in the Internet will need to be able to route datagrams to destinations in other routing domains not conforming to the addressing format proposed here. This is discussed in greater detail in section 6.

2. Introduction

The CLNP is documented in [1], but for matters of completeness the following illustration of the CLNP header is included here as Figure 1.

The addressing part of the header is the subject of this RFC, i.e., the source and the destination address, respectively. These addresses are generally discussed in [2] and [3], with this document presenting a specific method for addressing in the Internet environment, consistent with the international standardized NSAP addresses.

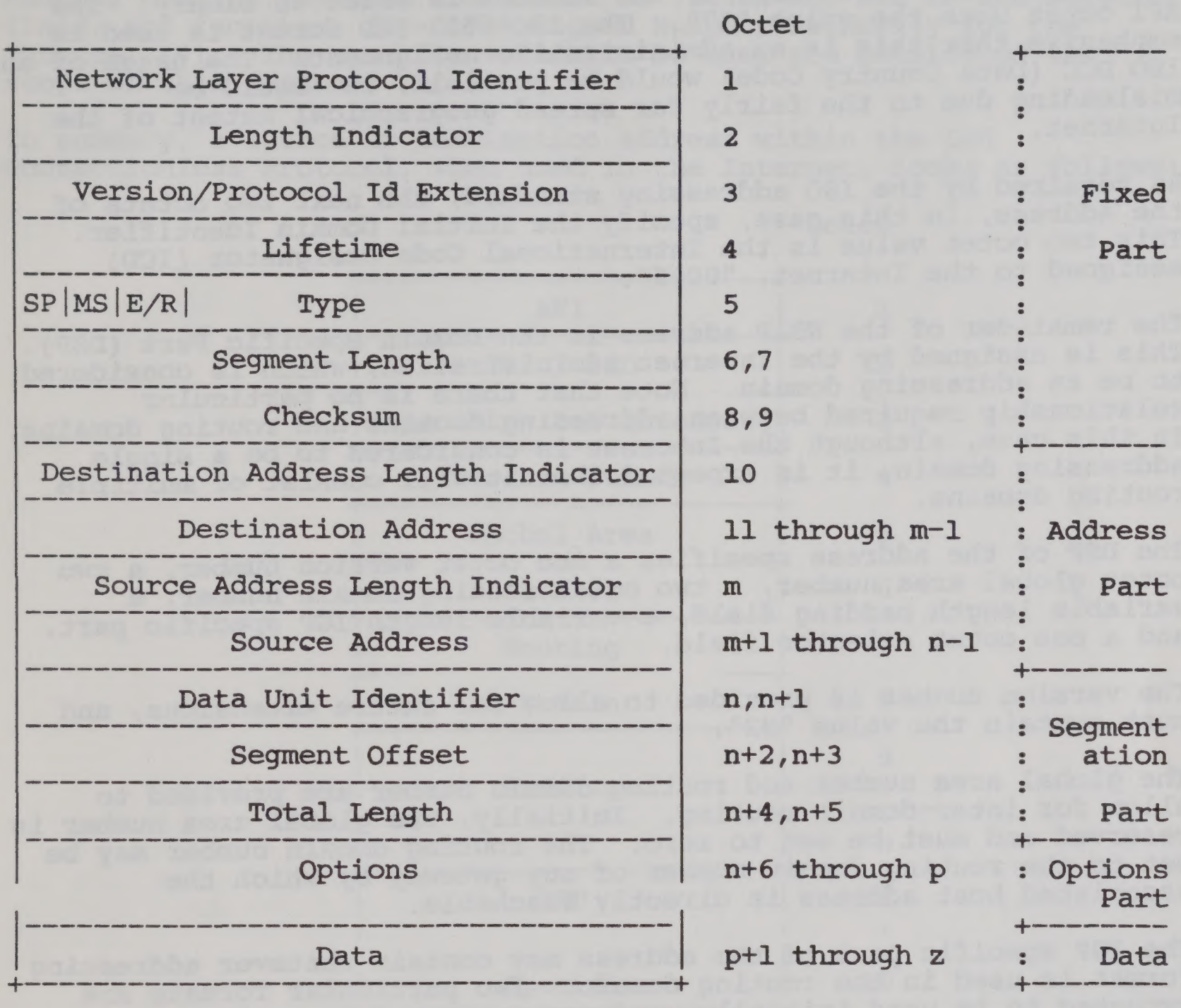

Figure 1: PDU Header Format

3. Addresses for Use in the Internet

This section describes the addresses used to address NSAPs in the Internet.

The appropriate Authority and Format Identifier (AFI) is one octet in length. It specifies an ISO-6523-ICD assignment, and also that the Domain Specific Part (DSP) of the address is based on binary. The AFI octet uses the value "47". The ISO-6523-ICD format is used to emphasize that this is an administrative assignment. The usage of an ISO DCC (Data Country Code) would be possible, but could be misleading due to the fairly far spread geographical extent of the Internet.

As required by the ISO addressing standard, the next two octets of the address, in this case, specify the Initial Domain Identifier. This two octet value is the International Code Designator (ICD) assigned to the Internet, "0006".

The remainder of the NSAP address is the Domain Specific Part (DSP). This is assigned by the Internet administration, which is considered to be an addressing domain. Note that there is no particular relationship required between addressing domains and routing domains. In this case, although the Internet is considered to be a single addressing domain, it is expected that it will consist of multiple routing domains.

The DSP of the address specifies a one octet version number, a two octet global area number, a two octet routing domain number, a variable length padding field, a variable length IGP specific part, and a one octet selector field.

The version number is provided to allow for future extensions, and must contain the value "02".

The global area number and routing domain number are provided to allow for inter-domain routing. Initially, the global area number is reserved and must be set to zero. The routing domain number may be set to the routing domain number of any gateway by which the associated host address is directly reachable.

The IGP specific part of the address may contain whatever addressing format is used in the routing domain. Two particular formats are expected to be used initially, and are presented in section 4. Padding is used so that the entire address will always be 20 octets in length.

The selector field performs the same function as the user protocol

field in the IP header. This is necessary because the ISO protocol considers identification of the user protocol to be an addressing issue, and therefore does not allow for the user protocol to be specified in the protocol header independently from the address.

The assignment of specific routing domain identifiers to defined routing domains, and the assignment of values for use in the selector field, are functions for the Assigned Numbers authority for the Internet [4]. The specific values to be used are outside of the scope of this document.

In summary, a source or destination address within the ISO Connectionless Protocol, when used in the Internet, looks as follows:

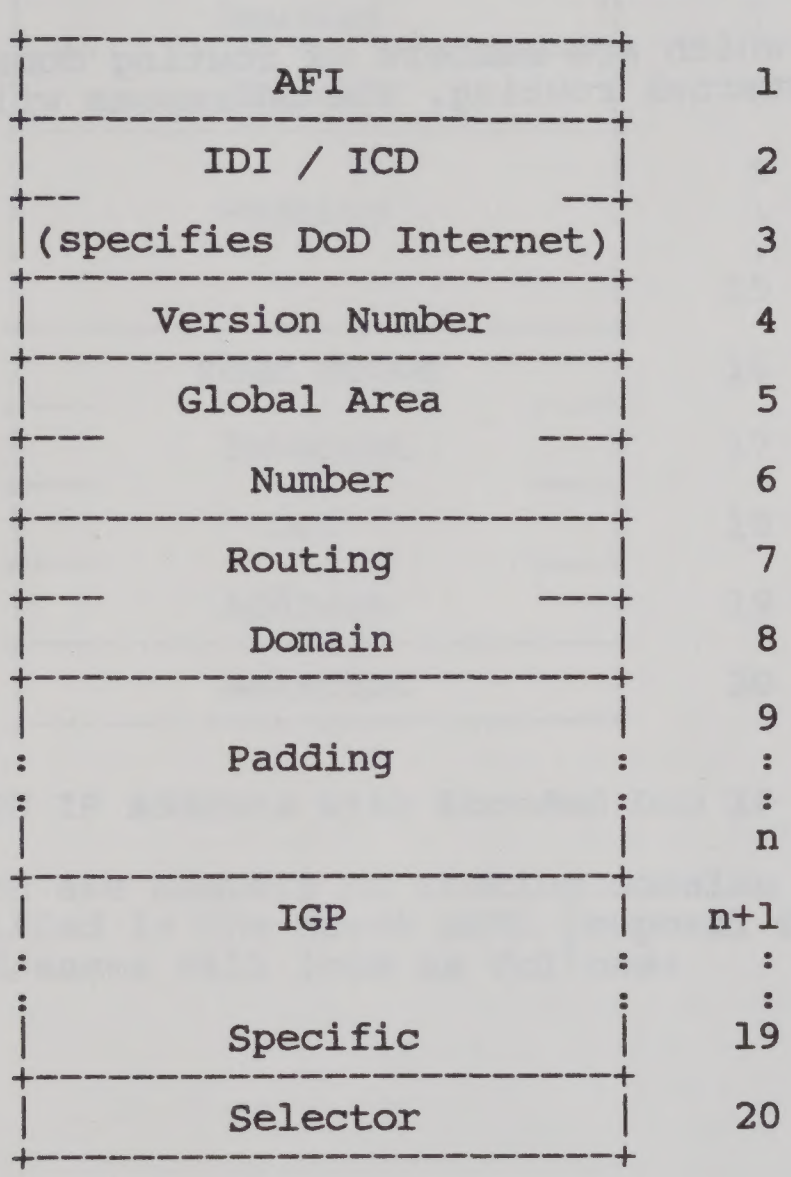

Figure 2: ISO IP address structure

The Authority and Format Identifier (AFI) is "47" (BCD). The Initial Domain Identifier (IDI) consists of the International Code Designator (ICD) assigned to the Internet, and must contain the value "0006". The Version Number must contain the value "02". The Global Area Number must contains the value "00". The Padding field is of variable length, but must contain the value zero.

4. Specific Values for use with the IGP specific field

In general, a particular routing domain may specify any addressing scheme for use with the IGP specific part of the address, up to 11 octets in length (consistent with the maximum address length of 20 octets). However, it is expected that initially addresses used in this field will consist of either the current IP addresses, or addresses conformant with those specified in the draft ANSI proposal for intra-domain routing.

For end systems which are members of routing domains using the IP addresses for internal routing, the addresses will look as follows:

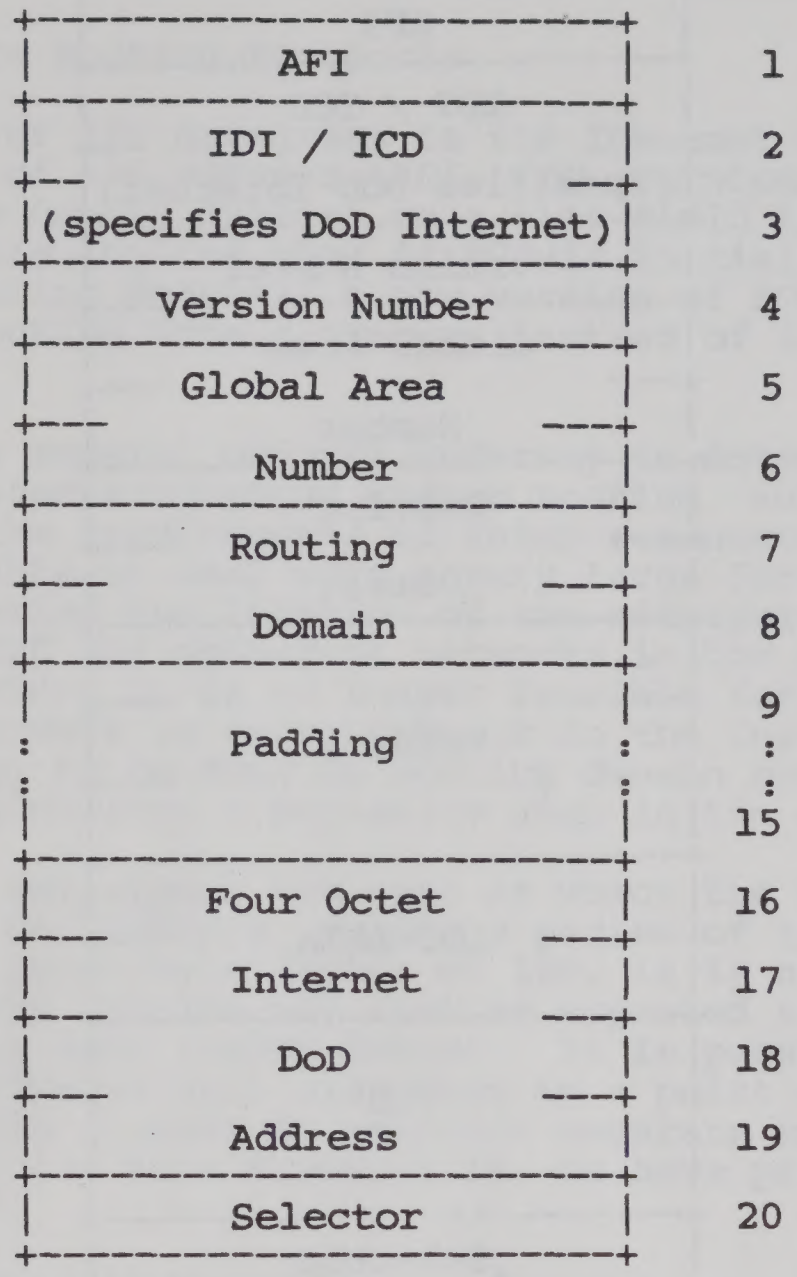

Figure 3: ISO IP Address with Encoded DoD IP Address

For end systems which are members of routing domains using the address format specified in the draft ANSI proposal for intra-domain routing [6], the addresses will look as follows:

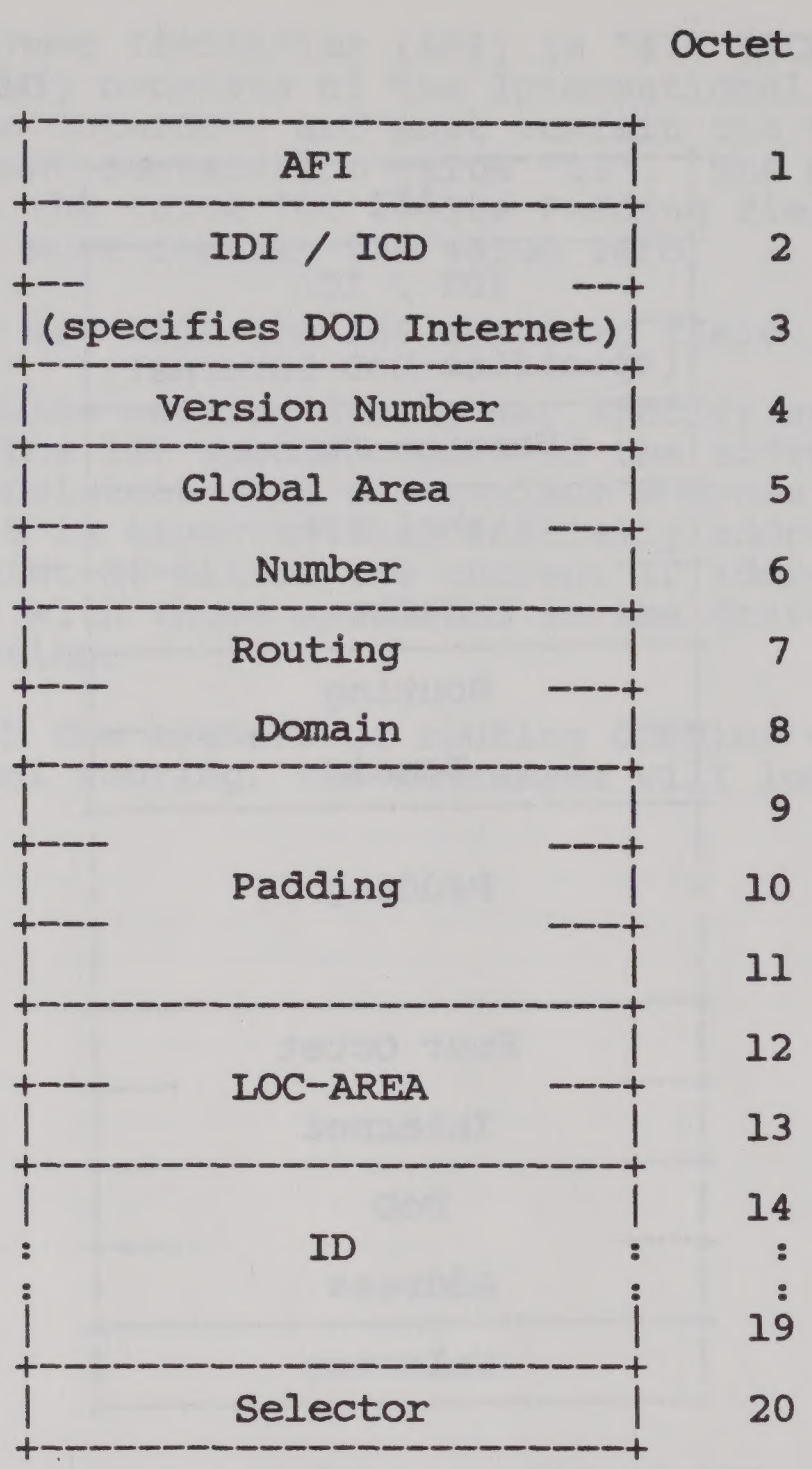

Figure 4: ISO IP Address with Encoded ANSI-format Address

5. Devices Attached to PDNs

Otherwise isolated end systems, which are attached to the Internet only indirectly via public data networks, and simple LANs which are similarly attached only via Public Data Networks, may make use of a separate address format based on their X.121 address. Such addresses may, for example, use the ISO-X.121 address format discussed in [3]. These addresses will need to be handled for routing purposes in much the same way as addresses in routing domains which have been

interconnected to the Internet, but which use other address formats, such as those specified by national standards bodies.

6. Migration to Future Routing Protocols

Initially, routing of ISO datagrams in the Internet may make use of the first 8 octets of the address (AFI, ICD, version, global area number, and routing domain number) as a flat field identifying the routing domain. This implies that if EGP is initially used for routing between routing domains, a new version of EGP may be required to carry 8 octet routing domain numbers instead of 3 octet network numbers.

There are currently several efforts underway to determine the requirements for inter-autonomous system routing, and to define a new protocol. One of the requirements of inter-autonomous system routing is the need to be able to deal with a very large Internet. It is anticipated that during the lifetime of the addressing scheme described in this RFC the number of networks in the Internet will grow to the point where it is no longer feasible for any gateway to maintain separate routes to every network in the Internet. Allowing inter-domain routing to be done by routing domain number instead of network number is therefore a necessary step in the long term.

It is difficult to anticipate the rate at which the number of routing domains may grow. For example, during a period of time in which the number of networks grows by a factor of 100, it is not clear whether the number of routing domains may also be expected to grow by a factor of 100, or by some lesser amount. It is possible that the number of routing domains will also grow to a point where it is not feasible for a single gateway to maintain separate routes to each. In order to prepare for this eventuality, we have provided for a "global area" field.

In the long term, it will be necessary for gateways to route to destinations which are in routing domains utilizing other addressing formats, specified by other organizations such as ANSI, ECMA, etc. In this case, it will not be possible to ensure that the first 8 octets of the address specifies the routing domain. In the long term, it will therefore be necessary to route based on variable length routing domain identifiers. It may be assumed that future inter-domain routing protocols will allow for specification of either (1) an address mask, specifying which part of an address is relevant for specifying those destinations which are reachable via a particular domain; or (2) a length field, specifying how many leading octets in a particular address are relevant. Specification of the details of such a routing protocol is beyond the scope of this document.

References

[1] ISO, "Protocol for Providing the Connectionless-Mode Network Services", RFC-926, ISO, December 1984.

[2] ANSI, "Guidelines for the Specification of the Structure of the Domain Specific Part (DSP) of the ISO Standard NSAP Address", RFC-982, ANSI Working Document X3S3.3/85-258, April 1986.

[3] ISO, Draft International Standard 8348/DAD2, "Information Processing Systems -- Data Communications -- Network Service Definition, Addendum 2 Covering Network Layer Addressing", RFC-941, April 1985.

[4] Reynolds, J. and J. Postel, "Assigned Numbers", RFC-1010, USC/Information Sciences Institute, May 1987.

[5] Callon, R. and H. W. Braun, "Working Draft -- Guidelines for the use of Internet-IP addresses in the ISO Connectionless-Mode Network Protocol," RFC-986, June 1986.

[6] ISO TC97/SC6/WG2 working document, "Intermediate System to Intermediate System Intra-Domain Routing Exchange Protocol".